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AN OUTFIT FOR SENDING BILE, SPECIMENS OF BLOOD, FECES, AND URINE, AND SOME RESULTS OF THE EXAMINATION OF SUCH MATERIAL.*

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IN order to enable the physician to make an early diagnosis in typhoid fever, and also to detect the presence of typhoid bacilli in the feces and urine of convalescents and carriers, we have been using two outfits. One of these has been submitted to the postal authorities and permission has been granted to use it.

The specimen for examination is placed in 5 c.c. of Conradi's bile medium in a test tube, stoppered with a rubber stopper, and covered with a rubber cap. This test tube is then placed in a cylindrical tin box made of I. C. bright tin plate with soldered joints. This box is closed by a metal screw cover and a rubber or felt washer. The test tube in the box is completely and evenly surrounded on all sides by closely packed absorbent cotton. The box with its contents is now placed upside down in a larger box prepared in exactly the same manner except that it is lined on the inside with compressed paper not less than $\frac{3}{16}$ of an inch in thickness to hold the inner box snugly (Fig. 1).

For work within the city limits we use a simpler outfit which cannot be sent through the mail. These outfits are distributed bimonthly to our culture stations; the physician inoculates the tube of bile medium with blood, feces, urine, or other material and sends it by a messenger to the laboratory. The tube containing bile medium has a rubber stopper and is wrapped in cotton and placed in a cylindrical pasteboard box with a screw top.

Both of these outfits also contain a swab for inoculating the bile medium with feces,[1] and an aluminum box in which drops of blood can be collected for tests, according to the Wesbrook method.

* Received for publication February 10, 1910.

[1] *Directions for cultures from the feces and urine of cases of typhoid fever, paratyphoid infections, epidemic dysentery, and convalescent or carrier cases from such diseases.*—Fifteen drops of urine should be put in the bile tube in order to detect the presence of the bacteria in this fluid. In order to take a culture from the feces, simply obtain about 1 gram or 15 grains of the feces on the cotton swab which will be found in the outfit. Rub this up in the bile and then burn the swab. Place the bile tube in the outfit in the same way it was found, and send to the department. Wrap the bile tube carefully in cotton before replacing it in the case. Please fill out the blanks to be found in the outfit.

The drops of blood are collected on the inner side of the top of the box and must be thoroughly dried before the lid is put on. The bottom of the box contains four cover-glasses for blood smears.[1]

By the use of these outfits the physician loses none of the advantages of the ordinary agglutination and blood-smear tests; on the other hand the bacillus of typhoid fever may be detected in the blood or feces before the agglutination test is positive. The typhoid bacillus is present in the blood in at least 90 per cent of the cases during the first week of the disease; consequently before agglutination

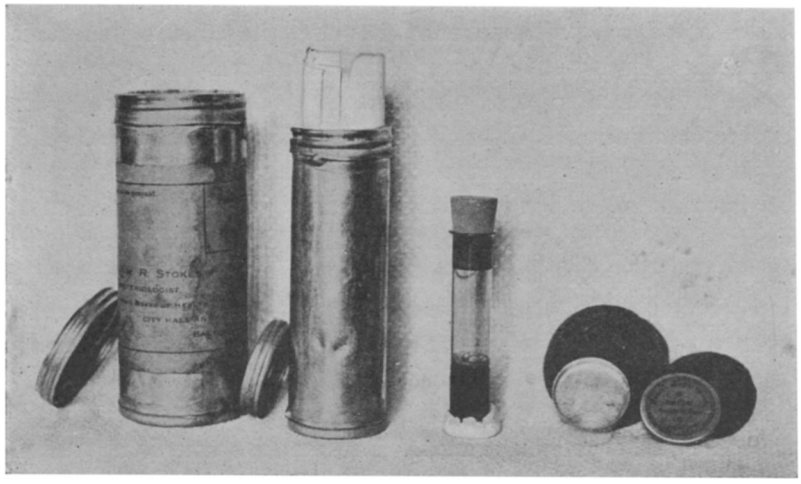

FIG. 1

appears. The outfits can also be used to determine when convalescents are free from typhoid bacilli, and there is just as much reason for examining the feces and urine of the convalescent typhoid patient as for making throat cultures from convalescent diphtheria patients.

[1] *Directions for obtaining a blood culture in typhoid fever and paratyphoid infection.*—In order to obtain a blood culture in cases of typhoid fever or paratyphoid infection, the finger-tip or lobe of the ear should be carefully washed and then disinfected with 1–1000 bichloride of mercury or 5 per cent carbolic acid. A large surgical needle, or better a regular blood stilet, should be used, after sterilizing, to puncture the finger or ear lobe. Ten drops of blood should then be allowed to flow into the tube of bile, which will be found in the case. The tube should then be stoppered as before, placed in the case with the rubber stopper up, and the outfit should be sent to the department. The typhoid bacillus is frequently found in the first week of the disease, when the Widal reaction is still negative. An early diagnosis may be thus secured.

They can be used also in searching for typhoid carriers in institutions and houses in which other causes of typhoid fever have been eliminated, and we have already been able to solve several such problems by this means.

We believe that in the future managers of large hotels, superintendents of various institutions in which many persons are gathered, dairymen, and even careful housewives will wish to know whether cooks or persons handling raw food harbor typhoid bacilli, and it is not inconceivable that certificates, showing that the feces and urine are free from typhoid bacilli, will be demanded of such persons.

By means of the outfits described we have studied 279 bile cultures which were sent to the laboratory by physicians. Four of these were from one case of cholecystitis, 62 from urine, 39 from stools, and 174 from the blood.

As stated, the materials for examination are placed by the physician in tubes containing 5 c.c. of sterile bile medium. Fifteen drops of urine and about one gram of feces are recommended as suitable quantities for inoculation. The tubes are incubated for 24 hours, when plates are made with Wurtz's litmus lactose agar. In a sterile Petri dish drops of broth are inoculated with individual colonies. Those consisting of gram-negative bacilli are mixt in hanging drops with antityphoid serum which agglutinates in a dilution of 1:100,000. A dilution of 1:10,000 is used for testing agglutination of suspected bacilli. Colonies agglutinated within two hours are considered to be typhoid colonies and inoculations are made in litmus milk, gelatin, potato, and glucose, lactose, and saccharose broth in fermentation tubes. All colonies giving positive results when tested in this manner so far have been found to give the cultural reactions characteristic of typhoid bacilli in these media.

Urine.—The typhoid bacillus has been isolated from the urine by a number of observers. It is seldom found before the end of the second week of the disease and may very rarely persist in the urine for years, Young[1] having demonstrated the organism in a case of post-typhoid cystitis seven years after the patient had recovered from typhoid fever, and Hunner[2] and Simon[3] each twenty years after the attack. Petruschky[4] found that the excretion of typhoid bacilli through the urine of typhoid patients is

[1] *Johns Hopkins Hosp. Rep.*, 1900, 8, p. 401.

[2] *Bull. Johns Hopkins Hosp.*, 1899, 10, p. 163.

[3] *Klin. Jahrb.*, 1907, 17, p. 362.

[4] *Centralbl. f. Bakt.*, Abt. 1, 1898, 23, p. 577.

relatively rare, and that as they are never found at the beginning of the disease their demonstration in the urine cannot be used as a diagnostic method. He also found that the excretion of typhoid bacilli in a few cases reached millions of organisms in 1 c.c. of urine, and persisted for weeks, hence this is of the greatest importance in the prophylaxis of typhoid fever. In 50 urines examined the typhoid bacilli were found three times. In one of the cases the bacilli were first observed at the beginning of the third week and persisted for two months. In the other two cases they appeared in the urine in from 6 to 10 days after the fever had disappeared and were present for 4 to 8 weeks respectively. In one case they were followed by a hemorrhagic nephritis. Richardson[1] in 38 cases found typhoid bacilli in the urine in nine, or 24 per cent, but only in the third week of the disease. Horton-Smith[2] reports a case of pyuria, beginning on the thirtieth day and lasting throughout a relapse, in the urine of which were many typhoid bacilli. Of 12 cases examined he found the organism present in the urine in only two. He found the length of time the bacilli persisted in the urine in 10 cases to be 8, 21, 25, 30, 70, 13, 18, 19, 34, and 40 days. The figures up to 13 are absolute, showing when the bacilli disappeared, but from 13 on, all that is known is that cultures were obtained up to the time indicated. The average duration, therefore, was 30 days after the temperature was normal.

Herbert[3] examined 228 urines of 98 convalescents and found 18, or about 18 per cent, with typhoid bacteria, but Thomas[4] in 196 convalescents found only seven whose urine contained typhoid bacilli.

Petruschky, Richardson, and Horton-Smith all failed to find the typhoid bacillus in the urine until after the fifteenth day, and Hiss[5] examined 75 cases during the first two weeks of the disease without finding typhoid bacilli in the urine of any. It can be safely stated, therefore, that typhoid bacilli appear in the urine only after the beginning of the third week, and even then they are found in only about 7 per cent of the cases, as seen in Table 1.

Even in convalescence they are not frequently found, the average of the different authors (Table 2) giving only 6 per cent of positive results. Herbert, by very exact observations in hospital cases, found that the typhoid bacilli disappear from the urine in from 8 to 27 days after the temperature has reached the normal, the average being about 15 days. The paratyphoid bacillus occurs in the urine in apparently 4 per cent of cases, and in 3 per cent of convalescents.

We have studied cultures from 62 specimens of urine inoculated in bile medium and have found the typhoid bacillus only once and the paratyphoid bacillus once. Both patients were convalescent. A number of the cultures studied were from patients who never had typhoid fever.

Stools.—It was formerly believed that the stools of typhoid patients were always swarming with the causative bacillus. This belief was in part due to the fact that the earlier bacteriologists claimed to have found the organisms without difficulty in nearly all stools from typhoid patients. Since the introduction of the agglutination test and the various differential culture media by Hiss, Drigalski-Conradi,[6] Hesse,[7] and others,

[1] *Jour. Exper. Med.*, 1898, 3, p. 349.
[2] *Lancet*, 1899, 1, p. 1346.
[3] *Münch. med. Wchnschr.*, 1904, 51, p. 472. *Klin. Jahrb.*, 1907, 17, p. 207.
[5] *Med. News*, 1901, 78, p. 726.
[6] *Ztschr. f. Hyg.*, 1902, 39, p. 283.
[7] *Ibid.*, 1908, 58, p. 641.

the isolation of the typhoid bacillus from the stools has become much simplified and its recognition easy. Table 2 shows, however, that in 5,844 specimens of typhoid stools examined by various authors during the disease the bacillus was present 1,185 times, or in 20 per cent of the cases. Simon[1] examined 870 stools and Müller and Gräf 255 stools and noted the day of the disease of each examination, and Table 3 shows the appearance of the bacilli according to the weeks of the disease.

TABLE 1.

THE OCCURRENCE OF TYPHOID AND PARATYPHOID BACILLI IN URINE.

A. TYPHOID BACILLI IN URINE DURING THE ATTACK.

Author	No. Cases Examined	Positive	Percentage
Thomas*.....	267	13	4
Hiss.....	75	0	0
Petruschky.....	50	1	2
Richardson.....	38	9	24
Horton-Smith.....	12	4	33
Blumer†.....	10	1	10
Müller and Gräf‡.....	170	17	11
Total.....	622	45	7

B. TYPHOID BACILLI IN URINE DURING CONVALESCENCE.

Thomas*.....	306	11	3
Herbert.....	228	18	7
Hiss.....	104	7	6
Petruschky.....	50	2	4
Blumer†.....	10	1	10
Müller and Gräf‡.....	46	6	13
Total.....	744	45	6

C. PARATYPHOID BACILLI IN URINE DURING THE ATTACK.

Thomas*.....	216	4	1.5
Müller and Gräf‡.....	43	7	16
Total.....	259	11	4

D. PARATYPHOID BACILLI IN URINE DURING CONVALESCENCE.

Thomas*.....	72	2	2
Müller and Gräf‡.....	20	1	5
Total.....	92	3	3

* *Klin. Jahrb.*, 1907, 17, p. 207.

† *Johns Hopkins Hosp. Rep.*, 1895, 5, p. 327.

‡ *Centralbl. f. Bakt.*, Abt. 1, Orig., 1907, 43, p. 856.

It is important from the standpoint of preventive medicine to determine how frequently the stools contain typhoid bacilli after convalescence has set in, and Table 3 also shows the percentage of positive findings after the temperature has become normal. In 703 cases examined the typhoid bacillus was found 19 times, or in 2 per cent of instances. This table also shows that the paratyphoid bacillus was found 33 times in 952 cases during the disease, or in 5 per cent.

Pratt, Peabody, and Long have collected 842 cases from various authors in which the typhoid bacillus was found in the stools 513 times. Some of these cases are included in our table.

[1] *Klin. Jahrb.*, 1907, 17, p. 232.

Table 3 indicates that the bacilli are present in the stools oftenest in the second week of the disease, quite frequently in the first week, and begin to disappear after the third week.

TABLE 2.

THE OCCURRENCE OF TYPHOID AND PARATYPHOID BACILLI IN THE STOOLS.

A. TYPHOID BACILLI IN STOOLS DURING THE DISEASE.

Author	No. of Cases	Positive	Percentage
Thomas	895	51	5
Krause*	360	230	64
Drigalski†	384	75	19
Simon‡	3,150	508	16
Pratt, Peabody, and Long¶	206	43	21
Klinger§	173	68	39
Lentz and Tietz**	180	20	11
Hiss	118	45	38
Krause and Stertz††	104	53	51
Hoffman and Ficker‡‡	19	15	78
Müller and Gräf	255	77	30
Total	5,844	1,185	20

B. TYPHOID BACILLI IN STOOLS DURING CONVALESCENCE.

Pratt	21	0	0
Thomas	466	15	3
Herbert	216	4	1.5
Total	703	19	2

C. PARATYPHOID BACILLI IN STOOLS DURING THE DISEASE.

Thomas	895	12	1
Müller and Gräf	57	41	70
Total	954	53	5

D. PARATYPHOID BACILLI IN STOOLS DURING CONVALESCENCE.

Müller and Gräf	31	12	3.5

* *Centralbl. f. Bakt.*, Abt. 1, Orig., 1904, 55, p. 723.
† *Klin. Jahrb.*, 1907, 17, p. 232 (cited by Thomas).
‡ *Ibid.*, 1907, 17, p. 229.
¶ *Jour. Amer. Med. Assoc.*, 1907, 49, p. 846.
§ *Arb. a. d. kais. Gesundh.*, 1906, 24, p. 35.
** *Munch. med. Wchnschr.*, 1903, 50, p. 439.
†† *Ztschr. f. Hyg.*, 1903, 44, p. 469.
‡‡ *Hyg. Runds.*, 1904, 14, p. 1.

We have studied 39 cultures from the stools. The typhoid bacillus was isolated from 11, or in 28 per cent of the cases, and the paratyphoid bacillus in 9, or 23 per cent of the cases. From one case both the typhoid and paratyphoid bacillus were isolated. Five of the positive results concern carriers, one having had typhoid fever 15 years before, a second 8 years before, a third 7 months before, and in two there was no history of typhoid. Outbreaks of typhoid were

traced to both of these cases, however, and as pointed out by Busse[1] it is probable that some bacillus carrriers do not develop typical typhoid fever even when the bacilli get into the blood. He obtained the bacilli from the blood of four persons with a severe infectious disease, but without any sign of typhoid fever during life or at autopsy.

TABLE 3.

THE OCCURRENCE OF TYPHOID BACILLI IN THE STOOLS ACCORDING TO WEEKS.

WEEK	SIMON		MÜLLER AND GRÄF		TOTAL		PERCENTAGE
	No. of Cases	No. of Positives	No. of Cases	No. of Positives	No. of Cases	Positive Results	
1.....	84	8	42	13	126	21	16
2.....	176	35	78	29	254	64	25
3.....	165	30	42	13	207	53	20
4.....	120	15	16	4	136	19	14
5.....	81	7	10	3	91	10	10
6.....	58	5	8	1	66	6	9
7.....	37	2	11	1	48	3	6
8.....	33	1	9	0	42	1	2
9.....	31	1	2	1	33	2	6
10.....	20	1	4	0	24	1	4
11.....	14	1	1	1	15	2	13
12.....	8	0	2	0	10	0	0
13.....	10	1	1	0	11	1	10
14 to 21....	33	1	1	0	34	1	3
	870	108	227	66	1,097	184	16

Blood.—In 1884 Gaffky[2] isolated the typhoid bacillus from the spleen in a case of typhoid fever and expressed the possibility of its being present in the blood. Castellani[3] was the first to isolate the typhoid bacillus from the blood during life. Since then the organism has been secured from the blood by many investigators, and the observations were collected by Coleman and Buxton[4] in 1907. We have added a number of cases from the more recent literature, bringing the data up to the present, the results being embodied in Table 4. Much of the earlier work concerned the question whether typhoid fever is a true septicemia and large quantities of blood were used in making the cultures. In 1901, however, Conradi[5] showed that bile possesses the property of keeping blood fluid, and in 1906 he proposed his method for hastening the growth of the bacilli in small quantities of drawn blood so as to make the culture available for diagnostic purposes.

Table 4 shows that in 2,359 blood cultures by various workers the typhoid bacillus was found in 1,625 instances, or in 68 per cent. Table 5 gives the percentage of positive blood cultures according to weeks. It shows that in the first week the typhoid bacillus was isolated from the blood in 78 per cent, in the second week in 69 per cent, in the third week in 57 per cent, in the fourth week in 32 per cent, and after the fourth week

[1] *Münch. med. Wchnschr.*, 1908, 55, p. 1113.

[2] *Mit. a. d. kais. Gesundh.*, 1884, 2, p. 372.

[3] *Centralbl. f. Bakt.*, Abt. 1, Orig., 1902, 31, p. 477.

[4] *Amer. Jour. Med. Sci.*, 1907, 133, p. 896.

[5] *Münch. med. Wchnschr.*, 1906, 53, p. 2387.

in 25 per cent of the cases. Müller and Gräf found the bacillus in the blood three times on the second, two times on the third, four times on the fourth, and once on the fifth day of the disease.[1]

TABLE 4.

SHOWING THE OCCURRENCE IN THE BLOOD OF

A. TYPHOID BACILLI.

Author	No. of Cases	Positive Results	Percentage
Coleman and Buxton	1,602	1,197	75
Conradi	60	21	35
Castellani	12	12	100
Peabody*	33	24	72
Veil†	210	206	98
Müller and Gräf	360	110	30
Peabody‡	82	55	62
Total	2,359	1,625	68
B. PARATYPHOID BACILLI.			
Schottmüller§	1	1	100
Conradi	60	3	5
Veil	210	13	6
Müller and Gräf	360	10	2
Total	631	27	4

* *Arch. Int. Med.*, 1908, 1, p. 149.

† *Deut. med. Wchnschr.*, 1907, 23, p. 1450.

‡ *Jour. Amer. Med. Assoc.*, 1908, 51, p. 978.

¶ Statistics collected by Coleman and Buxton.

§ *Münch. med. Wchnschr.*, 1904, 51, p. 294.

TABLE 5.

THE OCCURRENCE OF TYPHOID BACILLI IN BLOOD CULTURES ACCORDING TO WEEKS.

Authors	First Week			Second Week			Third Week			Fourth Week			After Fourth Week		
	No. Cases Examined	Positive	Percentage	No. Cases Examined	Positive	Percentage	No. Cases Examined	Positive	Percentage	No. Cases Examined	Positive	Percentage	No. Cases Examined	Positive	Percentage
Coleman and Buxton	224	200	89	484	353	73	268	178	73	103	39	39	58	15	26
Peabody	5	5	100	19	15	78	9	4	44						
Veil	32	24	78	105	66	63	44	19	43	20	4	20			
Peabody	17	17	100	37	26	70	28	12	42						
Müller and Gräf	57	17	29	96	44	45	36	10	27	19	3	15	16	4	25
Total	335	263	78	743	504	69	385	223	57	142	46	32	74	19	25

In our examinations of 174 cultures made from the blood the typhoid bacillus was isolated from 42 specimens, the paratyphoid bacillus from two, the pyocyaneus bacillus from two, and the colon

[1] Müller and Gräf's cases, like our own, were made from specimens sent by physicians to a municipal laboratory. The others were mostly made from hospital cases.

bacillus from one. From 22 cultures gram-staining micrococci were obtained; several of these proved to be the Staph. albus, probably derived from the skin of the patient in drawing the blood. One hundred and six of the specimens were sterile culturally and gave no agglutination, so we may consider our 47 positive cultures as coming from 68 cases, giving a positive percentage of 69.1. Cultures were made from the first up to the ninetieth day of the disease. The earliest positive cultures were obtained from two cases of two days' duration. Four positive cultures were obtained on the third day of the disease, six on the fourth, and three on the fifth day. Twenty-four or 51 per cent of the positive cultures were obtained in the first week of the disease, nineteen or 40 per cent in the second week, and three or 6 per cent in the third week, and in three the duration was not secured.

In 62 of the cultures the bile was incubated over night and the method recommended by Peabody of inoculating the water of condensation in a tube of blood serum was followed, and controlled by making plates with Conradi-Drigalski medium. The typhoid bacillus was recovered from the plates of 18 of these cultures, but in only nine instances did we secure a motile organism from the water of condensation in the blood-serum tube, and in one of these the organism was a gram-positive bacillus. The remaining cultures were made by merely incubating the bile tube over night, inoculating Wurtz agar, and making plates and incubating for 24 hours. At the end of this time the typhoid-like blue colonies were suspended in a few drops of sterile broth in a previously marked sterile Petri dish, the organisms from each suspension stained, and if gram-negative, hanging drops were made with antityphoid serum (agglutination strength of 1:100,000) at a dilution of 1:10,000, as well as a control drop without serum. If at the end of two hours agglutination and cessation of motility had occurred, the case was reported as typhoid. All positive colonies were inoculated into litmus milk, gelatin, potato, and glucose, lactose, and saccharose broth in fermentation tubes and, as stated, in every instance the bacilli gave all the cultural characteristics of the typhoid bacillus.

By this method we are able to make reports to the physician within 48 hours after receiving the specimen, and while the method

is not so rapid as the agglutination test, it must be emphasized that many of the positive cultures were obtained on the second and the third day of the disease.

When we meet with bacilli that do not agglutinate, we often feel that we must wait another 24 hours until it can be shown that they are not gas formers. In order to save this time we now inoculate glucose and lactose fermentation tubes with the bile after it has been incubated for 24 hours, and can thus rule out the paratyphoid and other gas-producing organisms at the same time that the agglutination of colonies is studied, namely, in 48 hours.

In seven cases the typhoid bacillus failed to agglutinate with immune serum or known typhoid blood. Our outfits always contain a specimen of the patient's own blood, however, and we use this also for testing the bacillus isolated from the bile culture. In all of these cases the bacillus was agglutinated with the patient's own blood. This test should always be carried out in order to aid in the identification of the organism. After several transfers to laboratory media four of the strains were agglutinated with known typhoid blood and immune serum (see Table 6).

The cultures from the pus in the case of cholecystitis, which is included in our series and which developed about three months after the patient had typhoid fever, gave typhoid bacilli in pure culture on each of four occasions.

It is interesting to note that this method will distinguish rare infections caused by B. pyocyaneus and B. coli from typhoid and paratyphoid fever, as strains of B. pyocyaneus and one of colon bacillus agglutinated with the patient's own blood. The paratyphoid bacilli isolated also agglutinated with the patient's own blood at a dilution of 1:50, or 1:200 of dried blood.

We have been able to find only one other instance in which B. coli was isolated from the blood during life, that of Czerny and Moser,[1] in which it was obtained from the blood of an infant.

The occurrence of primary pyocyaneus septicemia has been questioned by some who claim that this bacillus only appears in the blood following some more severe infection in which the general systemic resistance is lowered. Our cases in which the bacillus was obtained

[1] *Jahrb. f. Kinderh.*, 1894, 38, p. 430.

from the blood on the fourth day of the disease would seem to contradict this idea; in the second case agglutination was obtained on the tenth day of the disease. We are, therefore, led to believe that pyocyaneus bacillemia not only may be a primary disease but that further studies by means of blood cultures will show it to be more

TABLE 6.

AGGLUTINATION OF ATYPICAL TYPHOID BACILLI AND OTHER ORGANISMS.

CULTURE NO.	AGGLUTINATION	DURATION OF DISEASE	ORGANISM ISOLATED FROM CULTURE	DAY OF AGGLUTINATION			
				P.B.	T.B.	A.S.	PT.B.
126	0	14 days	B. coli	1	0	0	0
133	0	4 "	" typhosus	1	1	1	0
133	0	4 "	" paratyphosus	1	0	0	1
144	0	4 "	" pyocyaneus	1	0	0	0
167	0	21 "	" typhosus	1	0	0	0
174	0	10 "	" "	1	0	0	0
188	0	8 "	" paratyphosus	1	0	0	1
203	0	14 "	" typhosus	1	2	2	0
213	0	3 "	" "	1	0	2	0
231	0	10 "	" "	1	0	4	0
256	0	3 "	" "	1	0	0	0
259	0	14 "	" pyocyaneus	1	0	0	0
272	0	8 "	" typhosus	1	4	4	0

P.B.=patient's blood; T.B.=known typhoid blood at a dilution of 1:50; A.S.=antityphoid serum at a dilution of 1:10,000; PT.B.=known paratyphoid blood at a dilution of 1:50; figures denote the days of agglutination after organism was isolated.

common than generally believed at present. Our view is strengthened by the fact that in the literature are found several cases in which the clinical symptoms closely resembled those of typhoid fever, but which at autopsy showed no evidence of the latter disease and from which B. pyocyaneus was isolated. Cases of this kind are recorded by Channin, Ehlers, Oettinger. As shown by Waite who gives a thorough review of the literature on pyocyaneus infection,[1] B. pyocyaneus has been found in all organs after death, but only in seven authentic cases do we find that it was isolated from the blood during life (Blume, Boinet, Brill and Libman, Eastman and Keene, Finkelstein, Heubener, Rolly).

The agglutinin concentration in the blood in typhoid and paratyphoid fever.—Müller and Gräf have tested carefully the maximum dilution at which the blood of cases of typhoid fever would cause agglutination. They studied 203 cases, and found that the maximum dilution in 9 cases was 1:30, in 37 cases 1:50, in 37 cases 1:100, in 90 cases 1:200, in 8 cases 1:500, in 10 cases, 1:1000, in 10 cases 1:2000, in 1 case 1:2500, and in 1 case 1:5000. They also studied 28 cases of paratyphoid infection which gave no agglutination of typhoid bacilli. In these cases the maximum dilution

[1] *Jour. Infect. Dis.*, 1908, 5, p. 542.

was 1:100 in 3 cases, 1:200 in 9 cases, 1:500 in 8 cases, 1:1,000 in 2 cases, 1:2,000 in 4 cases, and 1:5,000 in 2 cases. Furthermore, they studied 14 cases of paratyphoid infection from which the organism was isolated; in 11 of these cases paratyphoid bacillus was agglutinated in much higher dilution than the typhoid bacillus; in the remaining three the reverse conditions obtained. All of the cases, however, gave a positive reaction with the typhoid bacillus in low dilutions.

The investigators also find that the blood from a typhoid fever patient will show great differences in the agglutinin strength with respect to different strains of typhoid bacilli. They examined 63 cases in which the maximum dilution was higher for one strain than for others. Some strains are but slightly agglutinable. In our work we made comparative tests of a large number of strains and selected for routine diagnosis one which agglutinated with maximum dilution in immune serum and typhoid blood.

CONCLUSIONS.

Physicians should use the bile-medium method in order to secure an early diagnosis in intestinal infections, as well as to determine when the various excretions are free from typhoid and paratyphoid bacilli.

Persons in large institutions who handle raw foods should have their feces and urine examined for typhoid bacilli, especially if there is a history of previous intestinal infection.

The bile method as here recommended will enable physicians to secure an early diagnosis of many of the intestinal infections by making cultures from the feces and blood. Rarer septicemias caused by B. pyocyaneus and other bacteria may also be detected.